CLAIMS

WHAT IS CLAIMED IS:

1. A method for controlling an induction motor, the motor having a rotor and a stator including a plurality of phase windings therein to which AC power is applied to cause rotation of the rotor relative to the stator, the method comprising:

receiving a rotor speed command signal;

receiving an indication of the phase winding current;

estimating a power factor based on the phase winding current;

estimating the rotor speed based on the estimated power factor;

comparing the estimated rotor speed and the rotor speed command signal to generate a speed error; and

adjusting a voltage signal applied to the phase windings in response to the speed error.

2. The method of claim 1, further comprising:

estimating a motor power value; and

estimating a slip value in response to the estimated power factor and power;

wherein the rotor speed is estimated based further on the estimated slip value.

3. The method of claim 2, wherein an inverter applies the voltage signal to the phase windings, further comprising:

determining a reference slip based on the rotor speed command signal; and

comparing the reference slip to the estimated slip to calculate a slip error;

wherein adjusting the voltage signal applied to the phase windings includes adjusting a voltage amplitude command signal received by the inverter in response to the slip error.

4. The method of claim 3, wherein adjusting the voltage signal applied to the phase windings includes adjusting a voltage frequency command signal received by the inverter in response to the speed error.

5. The method of claim 3, further comprising estimating the voltage applied to each of the phase windings, wherein the power factor and the motor power value are estimated based on the phase winding current, the voltage applied to each of the phase windings and the voltage amplitude and frequency signals.

6. The method of claim 5, wherein the inverter includes a DC bus having positive and negative lines and a plurality of inverter legs connected between the positive and negative lines corresponding to the phase windings, and wherein the voltage applied to each of the phase windings is estimated further in response to the DC bus voltage and the inverter leg current for the corresponding phase winding.

7. The method of claim 2, further comprising adjusting the estimated slip value in response to temperature.

8. An induction motor system, comprising:

a stator;

a rotor situated relative to the stator to rotate relative to the stator;

a plurality of phase windings situated within the stator;

a power source connected to the windings to output AC power thereto;

a controller connected to the power source, the controller estimating a power factor based on the AC power output to the windings and estimating the rotor speed based on the estimated power factor, comparing the estimated rotor speed to a rotor speed command signal to generate a speed error, and adjusting AC power in response to the speed error.

9. The induction motor system of claim 8, wherein the controller estimates a motor power value and estimates a slip value in response to the estimated power factor and power, wherein the rotor speed is estimated based further on the estimated slip value.

10. The induction motor system of claim 9, wherein the power source includes an inverter that applies a voltage signal to the phase windings, and wherein the controller

determines a reference slip based on the rotor speed command signal;

compares the reference slip to the estimated slip to calculate a slip error; and

adjusts a voltage amplitude command signal output to the inverter in response to the slip error.

11. The induction motor system of claim 10, wherein the controller adjusts a voltage frequency command signal output to the inverter in response to the speed error.

12. The induction motor system of claim 10, wherein the controller receives signals indicating the phase winding current, and wherein the power factor and the motor power value are estimated based on the phase winding current and the voltage applied to each of the phase windings and the voltage amplitude and frequency signals.

13. The induction motor system of claim 12, wherein the inverter includes a DC bus having positive and negative lines and a plurality of inverter legs connected between the positive and negative lines corresponding to the phase windings, and wherein the voltage applied to each of the phase windings is estimated further in response to the DC bus voltage and the inverter leg current for the corresponding phase winding.

14. The induction motor system of claim 9, wherein the controller adjusts the estimated slip value in response to temperature.

15. An drive system for an induction motor including a rotor and a stator including a plurality of phase windings therein, the drive system comprising:

a rotor speed estimator outputting an estimate of rotor speed and rotor slip;

a speed control loop receiving a speed command and the estimate of rotor speed, and generating a speed error in response to the difference between the speed command and the estimate of rotor speed, the speed control loop outputting a voltage frequency command in response to the speed error; and

a slip control loop determining a reference slip and receiving the estimate of rotor slip and the voltage frequency command, the slip control loop generating a slip error in response to the difference between the reference slip and the estimate of rotor slip, and outputting a voltage amplitude command in response to the slip error and the voltage frequency command.

16. The drive system of claim 15, wherein the rotor speed estimator estimates the rotor slip in response to an estimate of the motor power factor and power, and the voltage frequency and voltage amplitude commands.

17. The drive system of claim 16, wherein the power factor and power are estimated in response to the voltage and current applied to the phase windings.

18. The drive system of claim 15, wherein the estimate of rotor speed is adjusted in response to the motor temperature.

19. The drive system of claim 18, wherein the motor temperature is estimated based on an estimate of stator resistance.

20. The drive system of claim 15, wherein the rotor slip is estimated based on the product of a plurality of polynomials.